DOCUMENT RESUME

ED 319 797 TM 015 085

AUTHOR Emmons, Nancy J.; And Others
TITLE Statistical Methods Used in "American Educational Research Journal," "Journal of Educational Psychology," and "Sociology of Education" from 1972 through 1987.
PUB DATE Apr 90
NOTE 34p.; Paper presented at the Annual Meeting of the American Educational Research Association (Boston, MA, April 16-20, 1990).
PUB TYPE Information Analyses (070) -- Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Data Analysis; Educational Research; *Evaluation Methods; Literature Reviews; *Periodicals; Psychology; *Publications; *Research Methodology; Scientific Methodology; *Statistical Analysis; Trend Analysis
IDENTIFIERS American Educational Research Journal; Journal of Educational Psychology; Sociology of Education

ABSTRACT

The use of particular statistical methods over time was studied in a review of publications from the disciplines of education, psychology, and sociology. Publications studied were the: (1) "American Educational Research Journal"; (2) "Journal of Educational Psychology"; and (3) "Sociology of Education". A total of 221 issues of the three publications (2,674 articles) from the years 1972 through 1987 was reviewed. Statistical techniques were considered major if they were used to answer the key research questions or if understanding their meaning was integral to interpreting the mean results or findings. Frequencies and percentages of use are reported for 41 techniques. Overall, the techniques used most often were analysis of variance (37%) and regression (13%). Over the 16-year period, decreases were found for descriptive statistics, non-parametric statistics, chi square, multidimensional scaling, articles discussing statistical methodology, factor analysis, analysis of variance, book reviews, and commentary or debate articles. Increases were found for multivariate analysis of variance and covariance, multiple regression, and multiple correlation. Across the three disciplines, increases in the use of logit, probit, and log linear methods suggest trends toward adjusting methodology to account for the multiplicative and curvilinear nature of most social science research data. Five data tables are included. (SLD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

M. M. TAYLOR

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

ED319797

STATISTICAL METHODS USED IN AMERICAN EDUCATIONAL RESEARCH JOURNAL, JOURNAL OF EDUCATIONAL PSYCHOLOGY, AND SOCIOLOGY OF EDUCATION FROM 1972 THROUGH 1987

Nancy J. Emmons
Atlanta Public Schools

William M. Stallings and Benjamin H. Layne
Georgia State University

Paper presented at the Annual Meeting of the American Educational Research Association, Boston, Massachusetts, April 16-20, 1990.

TM015085

BEST COPY AVAILABLE

STATISTICAL METHODS USED IN AMERICAN EDUCATIONAL RESEARCH JOURNAL, JOURNAL OF EDUCATIONAL PSYCHOLOGY, AND SOCIOLOGY OF EDUCATION FROM 1972 THROUGH 1987

Nancy J. Emmons
Atlanta Public Schools

William M. Stallings and Benjamin H. Layne
Georgia State University

Background

A limited number of research studies have analyzed empirical studies as published in social science research journals to determine the extent of use of particular statistical methods and to examine trends in the use of these techniques over time. Nine of these studies were selected to serve as models for the current project because their research procedures closely parallel those of the present study, and because the results reported by the nine model studies provide a method for validating the results of the current study. Primarily, these nine studies were selected as models because they surveyed journals oriented toward research in the social sciences, while being considered educationally oriented, and had as their purpose a comparison of statistical methods, rather than simply being citation or productivity studies. The nine models were the following: (1) Goodwin and Goodwin, 1985a; (b) Goodwin and Goodwin, 1985b; (c) Elmore and Woehlke, 1988; (d) Edgington, 1964; (e) Edgington, 1974; (f) Willson, 1980; (g) West, Carmody, and Stallings, 1983; (h) McCartney, 1970; and (i) Rudolph, McDermott, and Gold, 1985.

Goodwin and Goodwin (1985a) conducted a study in which the statistical techniques used in the American Educational Research Journal from 1979 through 1983 were surveyed. Goodwin and Goodwin coded articles by the type of statistical techniques used and the "major" or "minor" importance for comprehending the research findings. The researchers found twenty-seven types of techniques. To address questions regarding generalizability, Goodwin and Goodwin compared their findings to a sample of articles from the Journal of Educational Psychology over the same five-year period. Goodwin and Goodwin coded all articles except book reviews. A total of 189 articles were examined. If techniques answered the key research questions or if their use was integral to interpreting the main results, they were considered "major." If techniques were part of the background, part of a preliminary analysis, an accompaniment to the major analyses, or mentioned as an

adjunct method, they were coded as "minor." Both the first and second authors of this study coded all of the articles independently to establish interrater reliability. The results were tabulated using numbers and percentages with chi square tests used to discern differences among "basic," "intermediate," and "advanced" techniques and between analysis of variance and regression techniques. Goodwin and Goodwin also published a similar article in the Educational Psychologist (1985b) describing the results of their survey of articles in the Journal of Educational Psychology from 1979 through 1983. Frequencies and percentages were reported. This study extended beyond the major statistical techniques to include post hoc procedures.

Elmore and Woehlke (1988) surveyed the statistical methods used in the American Educational Research Journal, Educational Researcher, and the Review of Educational Research over a ten-year period from 1978 through 1987. Elmore and Woehlke surveyed all of the articles in the three journals over the ten-year period and categorized all of the methods and techniques used in each article; therefore, the total coded methods exceeded the total number of articles reviewed. The first author (Elmore) coded the Educational Researcher articles, while the second author (Woehlke) coded the articles in the other two journals. As a check for reliability, the first year of articles were coded by both authors, and the inconsistencies were discussed, resulting in some changes of coding or categorization. Numbers only were reported with no percentages.

A study by Edgington (1974) examined the statistical procedures used in seven American Psychological Association journals, including the Journal of Educational Psychology, for the even-numbered years from 1964 to 1972. This study was a follow-up to an earlier study by Edgington (1964) in which statistical procedures used in American Psychological Association journals were surveyed from 1948 to 1962. For both of these studies, the author reported numbers of techniques by year with percentages based only on the articles using inferential statistics. Edgington did not use a check for reliability in either the 1964 or the 1974 study.

Willson (1980) surveyed the statistical techniques used in American Educational Research Journal articles over a ten-year period from 1969 to 1978. These results were compared to the previous study by Edgington (1974). All articles over the ten years were included except expository, statistical derivation, and book review articles. The total number of articles used was 280. The researcher was the only

coder. Willson used intrajudge reliability based on a ten percent random sample, stratified by year. Articles in the sample were recoded with agreement at ninety-six percent with most of the errors occurring in the first volumes. Frequencies and percentages were reported.

West, Carmody, and Stallings (1983) surveyed the quality of research articles in the Journal of Educational Research over the ten-year period from 1970 to 1980 by surveying the journals for two years, 1970 and 1980 only, and comparing the differences between the two years. Frequencies and ranks were reported for the various statistical techniques. Assessments of reliability and validity were not used in this study.

An article by McCartney (1970) in the American Sociologist surveyed the increasing use of statistics by sociologists in research studies. McCartney used a random sample of one-third of all articles in the American Journal of Sociology, the American Sociological Review, and Social Problems from their respective beginnings of publication through December 1964. Reliability and validity were not dealt with by the researcher. The results were reported in terms of percentages of use.

An article by Rudolph, McDermott, and Gold in the Journal of School Health (1985) surveyed the types of statistical techniques used in that journal over a five-year period from 1979 through 1983. Each article was categorized independently by two reviewers as a check for reliability. If the two raters could not agree on a category after discussion, a third rater was consulted. The results were presented in numbers and percentages.

The results of these nine model studies are varied. Willson (1980) reported that biology-based techniques of correlation, multiple regression, discriminant analysis, multivariate analysis of variance, and intraclass correlation comprised over forty percent of the techniques used in the American Educational Research Journal from 1969 through 1978 with the agriculture-based techniques of analysis of variance and analysis of covariance accounting for thirty-four percent of the techniques.

Edgington (1964 and 1974) found that the use of analysis of variance increased from eleven percent in 1948 to seventy-one percent in 1972, while the use of t-tests decreased over the same period of time from fifty-one percent in 1948 to twelve percent in 1972. Edgington surveyed seven American Psychological Association

journals in two separate, but later combined, surveys that covered twenty-five years in total.

Goodwin and Goodwin (1985a) found that approximately thirty-five percent of the techniques used in the American Educational Research Journal over a five-year period were correlation-based. The other techniques were descriptive, reliability or validity estimation, or other techniques. Goodwin and Goodwin counted t-test as analysis-of-variance-based for their study. Analysis-of-variance-based techniques accounted for over sixty percent of the techniques used in the Journal of Educational Psychology surveyed by Goodwin and Goodwin over the same five-year period.

Elmore and Woehlke (1988) found in their ten-year survey of the American Educational Research Journal, Educational Researcher, and the Review of Educational Research that analysis of variance and analysis of covariance were the most frequently used techniques when the numbers for all three journals were combined. These two techniques were also the most frequently used in the American Educational Research Journal and the Review of Educational Research, while Educational Researcher used descriptive statistics most often.

The ten-year survey of techniques used in the Journal of Educational Research by West, Carmody, and Stallings (1983) found that analysis of variance ranked first in its use, while analysis of covariance ranked eighth on a ten-point ranking scale based on frequencies. McCartney (1970) found that the highest percentage for techniques used in the American Journal of Sociology, the American Sociology Review, and Social Problems over seven decades was ascribed to descriptive statistics with nonparametric techniques as the second highest percentage and correlation as the third most frequent procedure. However, the McCartney (1970) article is almost 20 years old and may not represent current techniques in sociology. Later articles of this type in the field of sociology were not found. The Rudolph, McDermott, and Gold (1985) survey of statistical techniques used in the Journal of School Health over a five-year period found that analysis of variance had the third highest percentage of use in that journal falling closely behind the percentages of use for descriptive statistics and contingency tables.

Methods

The current study augments previous studies of this type by expanding the period of time examined from five or 10 years to 16 years and by involving the three disciplines of education, psychology, and sociology. This study is intended to expand the scope of previous studies across time (16 years) and space (three perspectives). To investigate the three social science perspectives while remaining relevant and dedicated to the cause of improving the field of educational research, the researcher selected American Educational Research Journal (AERJ), Journal of Educational Psychology (JEP), and Sociology of Education (SOE). All issues of the journals published from 1972 through 1987 were studied.

These three journals were selected because they contain a wide variety of statistical methodology in empirical research studies that pertain to education. They are published by the leading organizations in each respective field -- the American Educational Research Association, the American Psychological Association, and the American Sociological Association. These organizations have been acknowledged as the primary affiliations of scholars who conduct research in the fields mentioned (Lockheed & Stein, 1980). The three journals are highly ranked by professionals in the respective fields and have been used extensively in citation and productivity studies (Luce & Johnson, 1978; Mace & Warner, 1973; Koulack & Kesselman, 1975).

The American Educational Research Journal (AERJ) was published quarterly. For the 16-year period of this study (1972 through 1987), there were four issues per year for a total of 64 issues. These issues represented 732 articles and covered 8,475 pages of text. The average number of AERJ articles per issue was 11.44. The average number of authors per issue was 20.94. The Journal of Educational Psychology (JEP) was published bimonthly. JEP consisted of six issues a year, except in 1987 which included only four issues. Six issues were published for each of the first 15 years and four issues for the sixteenth year included in this study. A total of 94 issues were published, representing 1,543 articles and covering 13,216 pages of text. The average number of JEP articles per issue was 16.42. The average number of authors per issue was 34.09. The Sociology of Education (SOE) was published quarterly. Four issues a year were published during the 16-year period of this study, except 1982 in which the second and third issues were combined, resulting in only three issues for that year. The total number of SOE issues included in this study was

63, representing a total of 399 articles and covering 5,256 pages. The average number of SOE articles per issue was 6.33. The average number of authors per issue was 10.64. As shown in Table 1, overall descriptive statistics for the three journals that are the focus of this study include a total number of 221 issues with 2,674 articles covering 26,947 pages of text and involving 5,214 authors (with minimal duplication).

All of the data for this study were collected and analyzed by hand solely by the primary researcher. Six months were devoted exclusively to the data collection process. Color-coded index cards were used to record data for each article. For this study, every article with an author listed in the table of contents for each issue was coded. Articles were coded as book reviews, commentaries, theoretical articles, and empirical studies. Debates and rebuttals were coded as commentaries, while articles that used extensive reviews of the literature as the methodology were coded as theoretical articles. Articles that discussed statistical methodology or derivation but did not use any techniques for empirical research received a separate code. The Goodwin and Goodwin (1985a & 1985b) coding procedures discussed previously in this paper were used as a decision-making device. Statistical techniques were considered major when they were used to directly answer the key research question posed in the article or if understanding their meaning was viewed as integral to interpreting the mean results or findings (1985a). Techniques were not considered major if they were used as part of the background or the literature review, part of a preliminary analysis presented to accompany the major findings, or as an adjunct to the major technique. As in the study by Rudolph, McDermott, & Gold (1985), a statistical method was included if an author reported using it even if it were not fully discussed or the results appeared only in a table or a graph. There was a one-to-one match in the present study between the number of articles (2,674) and the total number of methodologies since each article received one code indicating its major methodology. Codes for all articles were aggregated under 41 statistical techniques that are listed in Table 2. Reliability was assessed using Krippendorff's (1980) method of stability assessment. Validity was addressed through a comparison of the findings with the results of the nine model studies. This method of assessing validity was used directly by Edgington (1964 and 1974) and Willson (1980) and indirectly by other model studies.

All of the studies that have served as models for the current research reported their findings in tables showing numbers and percentages or ranks for the various statistical procedures used in the journal articles. This study has used the same procedures for reporting the findings. Frequencies and percentages of use for the 41 aggregated statistical techniques found over the 16-year period are reported for each of the three journals and overall. To indicate trends over time, frequencies of each technique are reported in five- and six-year intervals by journal and overall for the 16 years included in this study. Chi-square was appropriately used by Goodwin and Goodwin (1985a) since the sample size was small. The present study uses the entire population of 2,674 observations; therefore, the use of chi square was not considered. According to Elifson, Runyon, and Haber (1982), the fundamental assumptions of chi square limit its use: ". . . An equally important limitation of chi square stems from the fact that the value of chi square is proportional to the sample size . . . . For this reason, many social scientists prefer to avoid chi square when dealing with large samples because the results can be very misleading. Indeed, it is difficult not to reject the null hypothesis when the sample size is over 1,000 cases." (p. 441-43) Because none of the other models for this research used statistics beyond frequencies and percentages or ranks, the researchers judged the use of those statistics to be sufficient.

A major statistical technique or methodology was assigned each article based on statements by the authors regarding the major methodology. If the author did not clearly state the major statistical technique, the researcher analyzed the situation based on knowledge and judgment and assigned a technique as major based on the criteria used by Goodwin and Goodwin (1985a, p. 7) and by Rudolph, McDermott, and Gold (1985, p. 231). Since many articles, especially in the American Educational Research Journal and the Journal of Educational Psychology, used from 8 to 10 different statistical techniques, the assignment of a major technique to each article was difficult.

Krippendorff (1980) stressed the importance of reproducibility in conducting research studies of this type. It is important that a study be reproducible; therefore, every effort has been made by the researchers to describe in detail the procedures used in this study. However, with the primary researcher serving as the only judge for categorizing the data, a problem with assuring high reliability was presented. Although intrajudge reliability was assessed using Krippendorff's stability

assessment, this technique for assuming reliability is the weakest and the least precise. The judge could easily have made the same misjudgment on the retest. The potential for error is greatest with this method. Ideally, a second or third judge should be used to assume higher reliability. The model study by Willson (1980) used the intrajudge method of assessing reliability by using a 10% sample of the first year as a retest. The same intrajudge method was used in the current study, but caution is advised since the intrajudge method of establishing reliability is the weakest.

A second precaution for this study lies in comparisons made to previous research studies that served as models. The current study is not intended to be an exact replication of any prior study. Other studies used different ranges of time, different journals, and other coding schemes. For example, book reviews and commentaries were deleted from most studies. Elmore and Woehlke (1988) tabulated all statistical procedures, including major and minor techniques, in the same summary. Theoretical articles were coded differently in various model studies. Statistical techniques were aggregated differently in each of the prior studies. Therefore, comparisons of the results of this study with similar studies should be undertaken with caution as this study is not a replication.

A third note of caution refers to comparisons made within this study across time and across disciplines. The number of issues per year varied depending on the year. The Sociology of Education combined the second and third issues in 1982, while the Journal of Educational Psychology split the year 1973 into two volumes with three issues in each volume, rather than the usual one volume with six issues each year, and published only four issues in 1987. Sources of random and systematic error in this study are found in the coding and manual tabulation of the data by the primary researcher and in the use of the intrajudge assessment of reliability. It is believed, however, that error in the present study is comparable to that of the nine model studies and has been reduced by the researcher's awareness.

A last note of caution is that the editorial policies of the three journals have served as an intervening variable that could have influenced the results of this study. Changes in these policies over the 16-year period must be considered. For example, the editorial policy of the American Educational Research Journal to publish reports of empirical and theoretical studies remained unchanged until 1987 when a change in editors resulted in a modification of the editorial policy to

encourage a wider variety of academic disciplines and articles using ethnographic research. Although the Journal of Educational Psychology editorial policy has remained unchanged over the 16-year period, editors have often requested more theoretical and qualitative articles. The editorial policy of the Sociology of Education has always encouraged all methodologies, but has become more interested in multimethod research in recent years.

Results

The results of this study are based on the analysis of 2,674 articles in 221 issues of three journals (AERJ, JEP, and SOE) covering 26,947 pages of text over a 16-year period from 1972 through 1987. Forty-one statistical and research methodologies are listed by code in Table 2. Each article was assigned one code by the primary researcher based on the criteria mentioned in the previous section. These 2,674 codes were then aggregated to yield 41 techniques. Several of the coded techniques include more than one closely associated technique. For example, Code 2 (nonparametric statistics) includes 23 different nonparametric statistical procedures; Code 20 (regression) consists of simple, multiple, lagged, and polynomial regression procedures; and Code 6 (correlation) includes simple, multiple, cross-lagged, and partial correlation. Every article with an author listed in the table of contents for each issue was coded and counted. Some articles, such as book reviews or commentaries may not have used a statistical technique, but were assigned a code in this study. In those cases the codes represent the major methodology used by the author, which may also describe the type of article. In other cases, such as content analysis (Code 19), the statistical technique may have been descriptive statistics (Code 1), but that code did not appear to capture the major methodology and was, therefore, considered the secondary rather than the major technique. Code 16 (statistical methodology) refers to articles that discussed derivation or statistics in general, but did not actually use a technique in research study. The researcher attempted to create exclusive and exhaustive categories in which each article was assigned only one code.

The tabulations of the frequencies and percentages for each of the 41 techniques in the three journals and overall are shown in Table 3. The highest percentages of techniques used overall during the 16-year period were analysis of variance (37%) and regression (13%). Within the individual journals, the highest percentages of techniques used by authors in AERJ articles were for analysis of

variance (23%) and regression (13%). The highest percentages of statistical techniques used by the authors of JEP articles were analysis of variance (52%) and regression (9%). The highest percentages of statistical techniques for SOE articles were regression (31%) and qualitative methodology (9%). Other popular methodologies or types of articles for the three journals include statistical methodology (6%) and multivariate analysis of variance (6%) for AERJ; multivariate analysis of variance (6%) and correlation (6%) in JEP; and analysis of variance (6%), path analysis (6%), and theoretical discussion (4%) in SOE. It was difficult to clearly categorize some SOE articles that used path analysis and regression since these methodologies overlap. In some cases, after careful consideration, regression was determined to be the major methodology, with path analysis as the secondary method.

Of equal importance to examining the frequencies and percentages of the techniques across the three disciplines is the investigation of the various methodologies over the 16-year time period by journal and for the combination of the three journals. In order to determine more easily the trends over time, the data were aggregated by five-year and six-year intervals and presented in Tables 4 and 5. As shown in Table 4, the use of factor analysis has declined over the 16-year period in AERJ, while the use of regression, meta-analysis, discriminant analysis, descriptive statistics, chi square, qualitative methodology, path analysis, Linear Structural Relations (LISREL), analysis of variance, analysis of covariance, multivariate analysis of variance and t-test showed noticeable increases over the 16-year period in AERJ. Book reviews, commentary or debate articles, and articles on statistical methodology decreased in use in AERJ over the time period.

Table 4 reveals that in JEP articles over the 16-year period the uses of descriptive statistics, nonparametric statistics, chi square, factor analysis, analysis of variance, and t-test have decreased. During the same time frame, the uses of mutitrait-multimethod, meta-analysis, articles concerning statistical methodology, regression, path analysis, LISREL, multivariate analysis of variance, and multivariate analysis of covariance have increased in JEP.

In SOE over the 16-year period descriptive statistics, nonparametric statistics, chi square, correlation, theoretical discussion, path analysis, analysis of variance, and t-test have decreased in the frequency of their use. As shown in Table 4, the use of

qualitative methodology, regression, logit and probit regression, log linear, and commentary or debate articles have increased in SOE.

Table 5 shows the frequencies and percentages for the combination of all three journals (AERJ, JEP, and SOE) over the 16-year period. Overall decreases were found for descriptive statistics, nonparametric statistics, chi square, multidimensional scaling, articles discussing statistical methodology, factor analysis, analysis of variance, book reviews, and commentary or debate articles. During the same period, increases in use were observed for multitrait-multimethod, meta-analysis, log linear, qualitative methodology, regression, logit and probit regression, path analysis, LISREL, analysis of variance and analysis of variance through the regression algorithm, discriminant analysis, analysis of covariance, multivariate analysis of variance, and multivariate analysis of covariance.

The question of the reliability of the results of this study has been addressed using Krippendorff's (1980) method of stability assessment in which an intrajudge test-retest measure was conducted on a 10% sample of the 173 articles from the combined journals for 1972. Eighteen articles were reassessed by the primary researcher in terms of the major methodology. One inconsistency was found, resulting in a reliability of .95. As a method of assessing validity, the studies used as models were examined to compare results, although it must be noted that this study was not intended as a replication study; therefore, the data collection and data analysis procedures may differ from those procedures used in the models. However, the results were strikingly similar among all of the model studies and in comparison to the present study.

Goodwin and Goodwin (1985a) found that analysis of variance and regression techniques accounted for the highest percentages of use, although the uses of descriptive statistics and correlation techniques followed closely behind. Goodwin and Goodwin indicated the trend toward an increase in the use of analysis of variance over the five-year study of AERJ. These findings are consistent with the findings of the current study since it was found that although analysis of variance appeared to be on the decline in JEP, SOE, and overall, this technique was showing an increase in use over time in AERJ. The second study by Goodwin and Goodwin (1985b) found that analysis of variance was the most frequently used technique in JEP. Correlation and regression were second and third in frequency of use.

Willson (1980) found that correlation and analysis of variance were the most frequently used techniques in AERJ. Regression was reported as the third most commonly used technique. Factor analysis was used by a relatively high percentage of AERJ articles, with its use declining over time. The Edgington studies (1964 and 1974) found that analysis of variance was used most frequently and that the use of that technique increased over time. Correlation and t-test were the second and third most commonly used methods in the Edgington studies.

McCartney (1970) found that the predominant statistical techniques had changed over time in sociology from essentially descriptive statistics to more analytic methods such as correlation and chi square. McCartney predicted that sociologists would soon be using more complicated methods, such as analysis of variance and analysis of covariance. West, Carmody, and Stallings (1983) found an increase in the use of multiple regression and multivariate techniques with a corresponding decrease in the use of correlation and nonparametric techniques. This study showed a slight increase in the use of analysis of variance. Elmore and Woehlke (1988) found that analysis of variance and analysis of covariance were the most frequently used techniques with multiple correlation and regression and descriptive statistics falling closely behind. Rudolph, McDermott, and Gold (1985) indicated that descriptive statistics, contingency tables, analysis of variance, and t-tests were the most commonly used techniques.

Conclusions and Discussion

The results of this research project indicate that empirical research studies across the three social science disciplines of education, psychology, and sociology have begun to recognize that the world is multiplicative, multivariate, and curvilinear. Increases in logit, probit, and log linear methods point to the trend toward adjusting methodology to account for the multiplicative and curvilinear nature of most social science research data. The multivariate characteristic of the social science research environment with its many confounding or intervening variables has been addressed through the trend toward increased use of multivariate analysis of variance and covariance, multiple regression, and multiple correlation. Increases in the use of techniques for statistical control, such as analysis of covariance and partial correlation, have occurred over the 16-year period from 1972 through 1987. These procedures allow the social science researcher to statistically equate groups with respect to variables that could be confounding and, thereby, gain control over

the multivariate features of human subjects and research data from educational settings.

Although analysis of variance, popular in educational research since the 1940's, remains the most frequently used statistical technique according to the combined results of this survey, this method appears to be decreasing in popularity. This decline in use was evident for JEP and SOE as well as overall, but was not reflected in the results from AERJ. Regression techniques now running closely behind analysis of variance in terms of frequency of use appear to be increasing in popularity over time. Qualitative methodology has increased in use for all three journals and overall during the 16 years. One surprising finding is that descriptive statistics, nonparametric techniques, and chi square, usually associated with sociology, have declined in use in SOE, while increasing in use in the more quantitatively oriented AERJ. Path analysis offers another surprise in that it has declined over time in SOE, while having shown increases in both JEP and AERJ. This finding is unusual since sociological research has been a key consumer of this methodology. The primary consistency across the three journals has been the increase over time in the use of regression, even by JEP. The decreases in the use of factor analysis in AERJ and JEP may be a result of the relegation of that technique to exploratory or measurement purposes. However, the prevailing statistical methods used by each journal and the changes in the use of methodologies over time may reflect the editorial policies of the journals as much as the major trends in research.

Multivariate methods, transformations such as logit or probit, and qualitative methodology have been popular over the past five years. Regression methods, including the use of analysis of variance and analysis of covariance through the regression algorithm, have been used more extensively in recent years. In fact, the decline in the use of analysis of variance and analysis of covariance may be explained by a gradual change toward the use of these procedures through the regression method. LISREL is not a widely used procedure but seems to be gaining in popularity. Discriminant analysis has been increasing steadily in use although still not widespread.

The results of the nine model studies were consistent with the current study and are an indication of the validity of the findings. The results of the models have corroborated those of the present study within the three disciplines and over time. The findings of all ten studies have been discovered to be exceptionally similar in

their analyses. However, the increases in qualitative methodology, transformations (logit, probit, log linear), and multimethod research may not have been adequately addressed in the nine model studies. The present study expands the scope of this type of research to include three disciplines and has provided a broader view of the situation. Although citation and productivity studies are relatively numerous, methodology surveys are not abundant (Goodwin & Goodwin, 1985a). The research questions of whether there are discernible differences in the use of various statistical techniques over time and whether there are differences across disciplines have been answered by the findings of the current study. As stated by Elmore and Woehlke (1988), a need exists for "periodic summaries of research techniques used in important journals" since it is impossible for professors of educational research and statistics courses to read all of the literature that students in their courses may encounter. The present study has augmented previous studies of this type by expanding the period of time to sixteen years, by including all issues over the 16-year period, and by crossing the three disciplines of education, psychology, and sociology while remaining relevant and dedicated to the cause of improving the field of educational research.

The significance of this study lies in its importance for professors and students of educational research. Trends over a 16-year period, as well as current practice, are crucial bits of knowledge that can help focus coursework and projects in the field and reveal which methods are most important for study in university courses burdened by the constraints of time. The findings from this study could be helpful for professors of educational research and statistics courses in terms of time management and decision-making. Adding to the findings of studies of this type is important since there are few surveys of statistical methodology and none that cross disciplines or extend over sixteen years using all issues of three journals. Implications are also apparent for publishers and scholars who would like to have research accepted for publication. Future trends are important for administrators of institutions of higher education in planning staff and courses to be offered. Knowing which statistical methods are increasing in acceptance and use and which methods are declining across three social science areas can better prepare students for the future.

REFERENCES

Edgington, E. S. (1974). A new tabulation of statistical procedures used in APA journals. American Psychologist, 29 (1), 25-26.

Edgington, E. S. (1964). A tabulation of inferential statistics used in psychology journals. American Psychologist, 19 (3), 202-203.

Elifson, K. W., Runyon, R. P., & Haber, A. (1982) Fundamentals of social statistics. Reading, MA: Addison-Wesley.

Elmore, P. B., & Woehlke, P. L. Research methods employed in American Educational Research Journal, Educational Researcher, and Review of Educational Research from 1978 to 1987. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA

Elmore, P. B., & Woehlke, P. L. (1988). Statistical methods employed in American Educational Research Journal, Educational Researcher, and Review of Educational Research from 1978 to 1987. Educational Researcher, 17 (9), 19-20.

Goodwin, L. D., & Goodwin, W. L. (1985a). Statistical techniques in AERJ articles, 1979-1983: The preparation of graduate students to read the educational research literature. Educational Researcher, 14 (2), 5-11.

Goodwin, L. D., & Goodwin, W. L. (1985b). An analysis of statistical techniques used in the Journal of Educational Psychology, 1979-1983. Educational Psychologist, 20 (1) 13-21.

Koulack, D., & Kesselman, H. J. (1975). Ratings of psychology journals by members of the American Psychological Association. American Psychologist, 30 (11), 1049-1053.

Krippendorff, K. (1980). Content analysis: An introduction to its methodology. Newbury Park, CA: Sage.

Lockheed, M. E., & Stein, S. L. (1980). The status of women's research in educational publications. Educational Researcher, 9 (2), 11-15.

Luce, T. S., & Johnson, D. M. (1978). Rating of educational and psychological journals. Educational Researcher, 7 (10), 8-10.

Mace, K. C., & Warner, H. D. (1973). Ratings of psychology journals. American Psychologist, 28 (2), 184-186.

McCartney, J. L. (1970). On being scientific: Changing styles of presentation of sociological research. The American Sociologist, 5 (1), 30-35.

Rudolph, A., McDermott, R. J., & Gold, R. S. (1985). Use of statistics in the Journal of School Health 1979-1983: A content analysis. Journal of School Health, 55 (6), 230-233.

West, C. K., Carmody, C., & Stallings, W. M. (1983). The quality of research articles in the Journal of Educational Research, 1970 and 1980. Journal of Educational Research, 77 (2), 70-76.

Willson, V. L. (1980). Research techniques in AERJ articles: 1969 to 1978. Educational Researcher, 9 (6), 5-10.

TABLES

TABLE 1

DESCRIPTIVE STATISTICS OF THREE JOURNALS FROM 1972 THROUGH 1987

Descriptive Statistic	Journal			Total
	AERJ[a]	JEP[b]	SOE[c]	
Number of				
Issues	64	94	63	221
Pages	8,475	13,216	5,256	26,947
Articles	732	1,543	399	2,674
Authors	1,340	3,204	670	5,214
Average Number of				
Articles/Issue	11.44	16.42	6.33	12.10
Pages/Issue	132.42	140.60	83.43	121.93
Pages/Article	11.58	8.57	13.17	10.08
Authors/Issue	20.94	34.09	10.64	23.59
Authors/Article	1.83	2.08	1.68	1.95

[a]American Educational Research Journal

[b]Journal of Educational Psychology

[c]Sociology of Education

Emmons, Stallings, & Layne
April 1990

TABLE 2

STATISTICAL TECHNIQUES USED IN THREE JOURNALS FROM 1972 THROUGH 1987

Code	Technique
1	Descriptive Statistics
2	Nonparametric Statistics
3	Chi Square
4	Fisher's Exact Test
5	Spearman Rank Correlation
6	Correlation (Simple, Multiple, Cross-Lagged, & Partial)
7	Canonical Correlation
8	Multiple Classification Analysis (MCA)
9	Commonality Analysis
10	Multitrait-Multimethod (MTMM)
11	Multidimensional Scaling
12	Trend Analysis
13	Meta-Analysis
14	Log Linear
15	Theoretical Discussion
16	Statistical Methodology
17	Historical Study
18	Qualitative (Ethnography & Case Study)
19	Content Analysis
20	Regression (Simple, Multiple, & Lagged)
21	Logit & Probit Regression
22	Path Analysis
23	Linear Structural Relations (LISREL)
24	Analysis of Variance (ANOVA) through Regression
25	Analysis of Covariance (ANCOVA) through Regression
26	Factor Analysis
27	Discriminant Analysis
28	Analysis of Variance (ANOVA)
29	Analysis of Covariance (ANCOVA)
30	Multivariate Analysis of Variance (MANOVA)
31	Multivariate Analysis of Covariance (MANCOVA)
32	Hotelling's T^2

TABLE 2 (Continued)

Code	Technique
33	Fisher's Z-test
34	z-test
35	t-test
36	Book Review
37	Commentary & Debate
38	Cluster Analysis
39	Time-Series
40	Profile Analysis
41	Latent Class Analysis

Emmons, Stallings, & Layne
April 1990

TABLE 3
Summary of Frequencies and Percentages of Statistical Techniques Used in AERJ[a], JEP[b], and SOE[c] from 1972 through 1987 (Percentages Rounded)

Statistical Technique	Journal						Total	
	AERJ		JEP		SOE			
	N	%	N	%	N	%	N	%
Desc. Stat.	16	2.19	13	.84	27	6.77	56	2.09
Nonparam.	5	0.68	12	0.78	17	4.26	34	1.27
Chi Square	8	1.09	34	2.20	17	4.26	59	2.21
Exact Test	0	0.00	2	0.13	0	0.00	2	0.08
Spearman	0	0.00	6	0.39	2	0.50	8	0.30
Correlation	24	3.27	92	5.96	9	2.26	125	4.68
Canonical	6	0.82	1	0.07	0	0.00	7	0.26
MCA	1	0.14	0	0.00	7	1.75	8	0.30
Commonality	1	0.14	1	0.07	0	0.00	2	0.08
MTMM	5	0.68	12	0.78	0	0.00	17	0.64
Multidim.	6	0.82	3	0.19	0	0.00	9	0.34
Trend. Anal.	4	0.55	1	0.07	0	0.00	5	0.19
Meta-Anal.	11	1.50	6	0.39	0	0.00	17	0.64
Log Linear	0	0.00	0	0.00	3	0.75	3	0.11
Theoretical	9	1.23	21	1.36	16	4.01	46	1.72
Stat. Meth.	46	6.28	13	0.84	5	1.25	64	2.39
Historical	0	0.00	0	0.00	3	0.75	3	0.11
Qualitative	13	1.78	1	0.07	37	9.27	51	1.91
Content Anal.	6	0.82	1	0.07	0	0.00	7	0.26

Table 3 (Continued)

Statistical Technique	Journal						Total	
	AERJ		JEP		SOE			
	N	%	N	%	N	%	N	%
Regression	94	12.84	139	9.01	123	30.83	356	13.31
Logit & Probit	3	0.41	1	0.07	12	3.01	16	0.60
Path Anal.	19	2.60	18	1.17	25	6.27	62	2.32
LISREL	10	1.37	8	0.52	4	1.00	22	0.82
ANOVA/Reg.	9	1.23	16	1.04	0	0.00	25	0.94
ANCOVA/Reg.	2	0.27	9	0.58	4	1.00	15	0.56
Factor Anal.	16	2.19	58	3.76	1	0.25	75	2.81
Discriminant	11	1.50	6	0.39	5	1.25	22	0.82
ANOVA	168	22.95	802	51.98	24	6.02	994	37.17
ANCOVA	21	2.87	74	4.80	5	1.25	100	3.74
MANOVA	42	5.74	97	6.29	2	0.50	141	5.27
MANCOVA	4	0.55	11	0.71	0	0.00	15	0.56
T^2	0	0.00	2	0.13	0	0.00	2	0.08
Fisher's Z	0	0.00	2	0.13	0	0.00	2	0.08
z-test	1	0.14	5	0.32	1	0.25	7	0.26
t-test	19	2.60	45	2.92	8	2.01	72	2.69
Book Rev.	119	16.26	0	0.00	2	0.50	121	4.53
Commentary	31	4.24	22	1.43	38	9.52	91	3.40
Cluster. Anal.	1	0.14	6	0.39	1	0.25	8	0.30
Time-Series	1	0.14	0	0.00	1	0.25	2	0.08
Profile Anal.	0	0.00	1	0.07	0	0.00	1	0.04
Latent Class	0	0.00	2	0.13	0	0.00	2	0.08
Total	**732**		**1,543**		**399**		**2,674**	

[a]American Educational Research Journal
[b]Journal of Educational Psychology
[c]Sociology of Education

TABLE 4
Frequencies of Statistical Techniques Used in AERJ[a], JEP[b], SOE[c] from 1972 through 1987 in Intervals

Technique	Journal								
	AERJ			JEP			SOE		
	1972-1976	1977-1981	1982-1987	1972-1976	1977-1981	1982-1987	1972-1976	1977-1981	1982-1987
Desc. Stat.	4	5	7	9	2	2	19	6	2
Nonparam.	0	2	3	5	4	3	15	2	0
Chi Square	0	4	4	15	10	9	13	2	2
Exact test	0	0	0	1	1	0	0	0	0
Spearman	0	0	0	5	1	0	2	0	0
Correlation	7	11	6	32	34	26	7	1	1
Canonical	3	0	3	1	0	0	0	0	0
MCA	0	0	1	0	0	0	0	0	0
Commonality	0	0	1	0	1	0	0	0	0
MTMM	0	3	2	1	4	7	0	0	0
Multidim.	4	1	1	3	0	0	0	0	0
Trend Anal.	0	2	2	0	1	0	0	0	0
Meta-Anal.	0	4	7	0	1	5	0	0	0
Log Linear	0	0	0	0	0	0	0	0	3
Theoretical	5	0	4	2	11	8	11	1	4
Stat. Meth.	26	15	5	2	3	8	2	2	1
Historical	0	0	0	0	0	0	2	0	1
Qualitative	1	2	10	0	0	1	8	7	22
Content Anal.	1	4	1	0	0	1	0	0	0
Regression	19	35	40	46	43	50	17	57	49
Logit & Probit	0	0	3	1	0	0	2	2	8

Table 4 (Continued)

Technique	Journal								
	AERJ			JEP			SOE		
	1972-1976	1977-1981	1982-1987	1972-1976	1977-1981	1982-1987	1972-1976	1977-1981	1982-1987
Path Anal.	0	8	11	1	3	14	17	5	3
LISREL	0	2	8	0	1	7	0	0	4
ANOVA/Reg.	3	4	2	2	11	3	0	0	0
ANCOVA/Reg.	0	0	2	1	7	1	0	3	1
Factor Anal.	12	1	3	22	21	15	0	0	1
Discriminant	1	2	8	2	4	0	3	0	2
ANOVA	45	47	77	336	248	218	15	6	3
ANCOVA	4	3	14	24	26	24	1	3	1
MANOVA	11	14	17	31	29	37	1	1	0
MANCOVA	1	1	2	3	0	5	0	0	0
T^2	0	0	0	0	1	1	0	0	0
Fisher's Z	0	0	0	0	1	1	0	0	0
z-test	1	0	0	3	0	2	0	1	0
t-test	3	6	10	14	20	11	4	3	1
Book Rev.	83	36	0	0	0	0	2	0	0
Commentary	23	6	2	6	10	6	9	15	14
Cluster Anal.	0	1	0	1	3	2	0	1	0
Time-Series	0	1	0	0	0	0	0	0	1
Profile Anal.	0	0	0	0	1	0	0	0	0
Latent Class.	0	0	0	0	0	2	0	0	0
Total	**257**	**219**	**256**	**569**	**505**	**469**	**150**	**123**	**126**

[a]American Educational Research Journal
[b]Journal of Educational Psychology
[c]Sociology of Education

TABLE 5
Frequencies and Percentages of Statistical Techniques Used in Combined Journals from 1972 through 1987 in Intervals (Percentages Rounded)

Technique	1972-1976		1977-1981		1982-1987		Total	
	N	%	N	%	N	%	N	%
Desc. Stat.	32	3.28	13	1.54	11	1.29	56	2.09
Nonparam.	20	2.05	8	0.95	6	0.71	34	1.27
Chi Square	28	2.87	16	1.89	15	1.76	59	2.21
Exact test	1	0.10	1	0.12	0	0.00	2	0.08
Spearman	7	0.72	1	0.12	0	0.00	8	0.30
Correlation	48	4.92	46	5.43	33	3.88	125	4.68
Canonical	4	0.41	0	0.00	3	0.35	7	0.26
MCA	0	0.00	5	0.59	3	0.35	8	0.30
Commonality	0	0.00	1	0.12	1	0.12	2	0.08
MTMM	1	0.10	7	0.83	9	1.06	17	0.64
Multidim.	7	0.72	1	0.12	1	0.12	9	0.34
Trend Anal.	0	0.00	3	0.35	2	0.24	5	0.19
Meta-Anal.	0	0.00	5	0.59	12	1.41	17	0.64
Log Linear	0	0.00	0	0.00	3	0.35	3	0.11
Theoretical	18	1.84	12	1.42	16	1.88	46	1.72
Stat. Meth.	30	3.07	20	2.36	14	1.65	64	2.39
Historical	2	0.21	0	0.00	1	0.12	3	0.11
Qualitative	9	0.92	9	1.06	33	3.88	51	1.91
Content Anal.	1	0.10	4	0.47	2	0.24	7	0.26
Regression	82	8.40	135	15.94	139	16.33	356	13.31
Logit & Probit	3	0.31	2	0.24	11	1.29	16	0.60

Table 5 (Continued)

Technique	1972-1976		1977-1981		1982-1987		Total	
	N	%	N	%	N	%	N	%
Path Anal.	18	1.84	16	1.89	28	3.30	62	2.32
LISREL	0	0.00	3	0.35	19	2.23	22	0.82
ANOVA/Reg.	5	0.51	15	1.77	5	0.59	25	0.93
ANCOVA/Reg	1	0.10	10	1.18	4	0.47	15	0.56
Factor Anal.	34	3.48	21	2.48	20	2.35	75	2.81
Discriminant	6	0.62	6	0.71	10	1.18	22	0.82
ANOVA	396	40.57	300	35.42	298	35.02	994	37.17
ANCOVA	29	2.97	32	3.78	39	4.58	100	3.74
MANOVA	43	4.41	44	5.20	54	6.35	141	5.27
MANCOVA	4	0.41	4	0.47	7	0.82	15	0.56
T^2	0	0.00	1	0.12	1	0.12	2	0.08
Fisher's Z	0	0.00	1	0.12	1	0.12	2	0.08
z-test	4	0.41	1	0.12	2	0.24	7	0.26
t-test	21	2.15	29	3.42	22	2.59	72	2.69
Book Rev.	85	8.71	36	4.25	0	0.00	121	4.53
Commentary	38	3.90	31	3.66	22	2.59	91	3.40
Cluster Anal.	1	0.10	5	0.59	2	0.24	8	0.30
Times-Series	0	0.00	1	0.12	1	0.12	2	0.08
Profile Anal.	0	0.00	1	0.12	0	0.00	1	0.04
Latent Class	0	0.00	0	0.00	2	0.24	2	0.08
Total	**976**		**847**		**851**		**2,674**	